Macrorremains evidence of anthropogenic recession of *Pinus nigra* Aiton in Northern Spain

García-Amorena Ignacio, Moreno Amat, E, Iglesias González R, Rubiales JM, Gómez-Manzaneque F

E.T.S.I. Montes (Dpto. Silvopascicultura), Universidad Politécnica de Madrid. Avda. Ramiro de Maeztu s/n, 28040 Madrid

CONTACT: ignacio.garciaamorena@upm.es

Introduction

The natural forest landscape of the Duero Basin in Spain's Northern Meseta is now reduced to small masses, its demise largely owed to the intense agricultural and stock-raising use made of its lands. The composition of the scant natural masses suggests that formations dominated by broadleaved species once occupied a much greater area.

This idea has led to the believe that pine trees have few place within the natural dynamics of this area (Carrión and Fernández, 2009). However, *P. pinaster* Aiton and *P. pinea* L. on low-land sandy areas, *P. sylvestris* L. and *P. uncinata* Ramond ex DC on mountain high areas have been demonstrated to have played an important role during the Holocene (Franco et al., 2005; Rubiales et al., 2010).

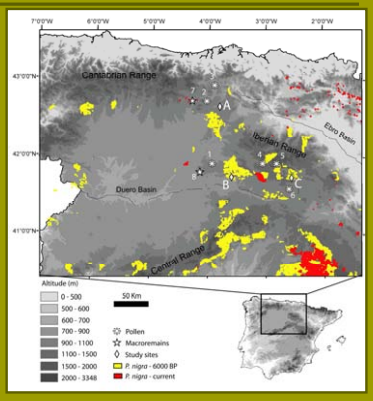
The abundant plant remains and moulds of pine wood and cones found on Northern Meseta peat bogs and travertines, now demonstrate its presence on mid-lands during the Quaternary until the last millennia.

Study sites

STUDY SITES (rombs)
A-Tubilla del Agua
B-Tubilla del Lago,
C-Fuentetoba

1: Espinosa de Cerrato (Franco Múgica et al., 2001)
2: La Piedra (Ramil-Rego et al., 1998)
3: Valle de la Nava (Menéndez Amor, 1968)
4: Quinatanar de la Sierra (Peñalba et al., 1997)
5: el Hornillo (Gómez-Lobo, 1993)
6: Quintana Redonda (García Antón et al., 1995).
7: Aguilar de Campoo (Alcalde et al., 2001)
8: Cevico Navero (Roig et al., 1997)

Orange: The natural distribution of *P. nigra* (Ceballos et al., 1966)
Yellow: that modelled by Benito et al. (2007) for 6000 years BP



Material and Methods

Between 2007 and 2009 a peat bog (Tubilla del Lago) and two travertine complexes (T. del Agua and Fuentetoba) were investigated.

The wood remains were identified via comparative anatomical studies (Greguss, 1955; Jacquiot, 1955; Wheeler et al., 1989; Schweingruber, 1990) making use of thin sections prepared in all three main planes. The pine cones and travertine moulds were identified by examining the external border of the apophysis, the position and the shape of the mucron in the umbo. All material was compared with a the reference collection.

Radiocarbon dating was performed by Beta Analytic Inc. (Miami, USA) and the CNA (Seville, Spain). Dates were calibrated to cal BP using the online Calib 6.0htlm software and the INTCAL09 dataset (Stuiver et al., 2005; Reimer et al., 2009).

Tubilla del Lago (Burgos) **Tubilla del Agua (Burgos)** **Fuentetoba (Soria)**

Results

At Tubilla del Agua, a total of 17 trunk sections and 71 pine cones were collected. Up to fifteen pine cone moulds were found at Tubilla del Agua in four different places. At Fuentetoba, a pine cone mould was found from the rubble.

WOOD DETAILS

The absence of thick epithelial cells in the resiniferous channels, the window-like crossfield pits, and the sharp dentitions on the walls of the radial tracheids, allowed the wood specimens to be assigned to the P. sylvestris / P. nigra group

CONE DETAILS

The rounded end of the external margin of the apophysis in all the pine cones (R), and the hook-like mucron eccentrically (HE) located in the umbo, showed all the strobily to belong to *P. nigra*.

All the collected samples were of Holocene age. The C13/C12 values of the CaCO3 based samples from Fuentetoba and Tubilla del Agua, were around 10‰, validating the dates returned (Ali et al., 2003).

SITE	SAMPLE CODE	TYPE	^{14}C AGE (BP)	-13C/12C (‰)	2σ CALIBRATED AGE (cal BP)	2σ CALIBRATED AGE (cal BC)
T. DEL LAGO	Beta-243303 (TUB G01)	wood	3160±50	- 25.3	3260-3480	1310-1530
	CNA-171 (TUB-A-04)	wood	3680±70	- 26.53	3840-4230	1890-2280
	CNA-172 (TUB-D-04)	wood	3150±70	- 24.77	3210-3550	1260-1600
FUENTETOBA	Beta-260005 (TOBA SO.01)	$CaCO_3$	8220±50	- 10.4	9020-9400	7070-7450
T. DEL AGUA	Beta-260006 (TUAG.BU.01)	$CaCO_3$	2650±40	- 9.6	2730-2850	780-900

Site	Samples	Type	Cone length (cm)	Cone width (cm)	Apophysis length (cm)	Apophysis width (cm)	Scale shape	Mucron	Taxon
T. del Lago	TUB	71 Cones	4.45 ± 0.61	2.82 ± 0.33	0.83 ± 0.68	0.70 ± 0.42	R	HE	*P. nigra*
T. del Agua	TUAG.BU.01	1 mould	--	3.1	0.85 ± 0.05	0.75 ± 0.05	R	HE	*P. nigra*
	TUAG.BU.02	4 moulds	--	2.43 ± 0.01	0.56 ± 0.13	0.52 ± 0.12	R	HE	*P. nigra*
	TUAG.BU.03	9 moulds	4.38 sample 8	2.63 ± 0.58	0.51 ± 0.08	0.72 ± 0.13	R	HE	*P. nigra*
	TUAG.BU.04	1 mould	--	1.53	0.26 ± 0.043	0.36 ± 0.04	R	HE	*P. nigra*
Fuentetoba	TOBA SO.01	1 mould	4.42	3.04	0.76 ± 0.06	0.091 ± 0.05	R	HE	*P. nigra*

Conclusions

Over the Holocene, changes of up to 2ºC in mean annual and mean summer temperatures, and of about 100 mm in annual rainfall are estimated for the Northern Iberian System, with a thermal maximum being reached about 6000 years BP (Peñalba et al., 1997). Given the current growth sensitivity shown by *P. nigra* to summer temperatures (Génova, 2000), this must have been the most critical period for this species. In other areas of the Iberian Peninsula formations of *P. pinaster* managed to survive in limiting climatic conditions until some catastrophic event led to the species' collapse (Carrión et al., 2001). It is unlikely, however, that masses of *P. nigra* found themselves in such an unstable scenario during the Holocene; indeed, the species shows signs of enjoying vitality at this period (García Antón et al., 1995; Franco Múgica et al., 2001; Benito Garzón et al., 2007).

Palynological evidence from the Quintanar de la Sierra (Peñalba et al., 1997), La Piedra (Ramil-Rego et al., 1998), Valle de la Nava (Menéndez Amor, 1968) and Espinosa de Cerrato (Franco Múgica et al., 2001) sites suggests that the landscape fell under anthropic control within the last 1000 years. Compared to other areas of the Iberian Peninsula (e.g., the Ebro Valley or the valleys facing the Cantabrian coast) where evidence of Neolithic culture goes back more than 3000 years, this anthropization is relatively late (Zilhão, 1993; Iriarte, 2003). This reflects the expansion of resource use into climatically tougher (continental/mountainous) areas after the Castilian Reconquest (Rubiales et al., 2007). The use of fire to clear land for crops and stock raising, the great value of *P. nigra* for construction and as a fuel, and the poor rebound capacity of the species are the most likely reasons for its demise in favour of pasture, crops and broadleaved plants.

Key references

Franco et al., 2005
Rubiales et a., 2010
Franco et al., 2001
Rubiales et al., 2007
Gª-Amorena et al., submitted
García Anton 1995, Alcalde, Roig